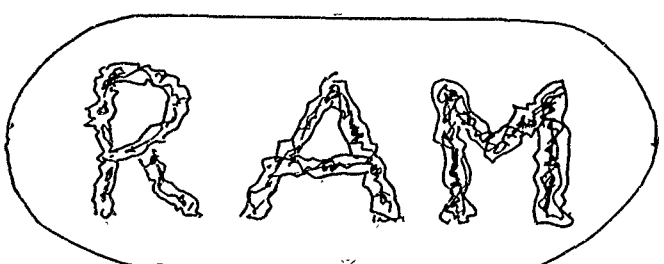
DRAFT VIEW GRAPHS

CECOM CORROSION PREVENTION & CONTROL

(CCPC)

TRAINING COURSE



INTRODUCTION

GENERAL:

DEFINITION OF CORROSION
IMPACT ON ARMY/CECOM
QUALITY CONTROL ASPECTS

SCOPE:

CECOM CORROSION
DARCOM R 702-24
CECOM SUPPLEMENT UPDATE
CECOM PAM 702-XX
APPLICATION GUIDE

COURSE OUTLINE:

CCPC: DEFINITION OF CORROSION

- UNDESIRABLE DETERIORATION OF METALS
- RESULTS FROM REACTIONS OF METALS WITH THE ENVIRONMENT
- ELEMENTS OF CORROSION:
  - = MOISTURE
  - = CONTAMINANT
  - = METAL OR METALS
  - = EMF'S (VOLTAGE POTENTIAL)

CCPC: IMPACT ON ARMY/CECOM

- CORROSION: MAJOR CAUSE OF EQUIPMENT FAILURES
- OVERALL ANNUAL LOSSES IN THE HUNDRED OF MILLION DOLLARS
- MAJOR CAUSES OF:

  LOW EQUIPMENT AVAILABILITY

  HIGH MAINTENANCE COSTS

  LOW RELIABILITY

  LOW SERVICE LIFE

CCPC: QUALITY CONTROL ASPECTS

- SPECIFICATIONS & STANDARDS LAG TECHNOLOGY
- MATERIAL SELECTION, PARTS CONTROL, DESIGN DECISIONS ACCOMPLISHED WITHOUT ADEQUATELY CONSIDERING CORROSION IMPACT.
- LACK OF A SPECIFIC CORROSION TEST APPLICABLE TO ELECTRONICS
- COSTLY FAILURE ANALYSIS, VISUAL PASS/FAIL CRITERIA
- LIMITED VISUAL INSPECTIONS
- LACK OF A STANDARD MEASUREMENT CRITERIA FOR ELECTRONIC EFFECT
- MINUTE CORROSION INCIDENCE GENERALLY CONSIDERED HARMLESS
- LACK OF CORROSION PREVENTION TRAINING
- ELECTRONIC CORROSION NOT A CURRENT TECHNICAL FIELD OR DISCIPLINE

CECOM CORROSION

- CORROSION INSPECTIONS OCCUR ONLY IN VISIBLE ELECTRONIC HARDWARE
- NOT A WELL-DEFINED FIELD
- MINIMAL DATA SOURCES
- ITEMS:
  - ANTENNAS
  - WAVEGUIDES
  - CONNECTORS, PINS, SOCKETS
  - RELAYS
  - SWITCHES
  - CASE HARDWARE, GASKETTED ENCLOSURES
  - PARTS, LEADWIRES, ELEMENT BONDS
  - TRANSISTORS, HEADERS, PINS

CECOM CORROSION (CONT'D)

KOVAR-GLASS SEALS
PLASTIC ENCAPSULATED TRANSISTORS, IC'S, MICROMODULES
PRINTED CIRCUIT ASSEMBLIES, CONNECTORS, PRINTED LINES
SOLDERED-THRU-HOLES, LEADWIRES, TABS
GROUND CONNECTIONS, SOLDERING JOINTS

- ITEM FAILURES I.E. OPEN CIRCUIT, SHORTS, MALFUNCTION; USUALLY NOT INVESTIGATED FOR ROOT CAUSE

DARCOM R 702-24

(CECOM SUPPLEMENT #1)

- DARCOM REG. 702-24, DATED OCTOBER 1979
  MATERIEL DETERIORATION PREVENTION & CONTROL (MADPAC)

  ESTABLISHES REQUIREMENTS, RESPONSIBILITIES, & ACTION PROGRAMS REQUIRED FOR ALL DARCOM MATERIEL AND MAJOR SUBORDINATE COMMANDS.

DARCOM R 702-24 (CONT'D)

- CECOM SUPPLEMENT #1, DATED 22 FEBRUARY 1984
  FURTHER SUPPLEMENTS 702-24 BY; DELINEATING THE FOLLOWING:

  DIRECTOR OF PA&T, CECOM WILL IMPLEMENT THE PROGRAM
  ESTABLISH A CECOM DETERIORATION PREVENTION AND CONTROL
  OFFICE (DPAO)
  MANAGE THE OVERALL MADPAC PROGRAM
  CALLS UPON PM'S AND CHIEF OF DEVELOPMENT CENTERS TO PROVIDE
  PARTICIPATION IN A CECOM DETERIORATION PREVENTION TECHNICAL
  WORKING GROUP
  INSURE THAT ALL CONCERNED PERSONNEL ARE INSTRUCTED AS TO
  CAUSE, EFFECTS, AND TECHNIQUES FOR CORROSION PREVENTION

CECOM PAMPHLET 702-XX

DEVELOP A FORMAT AND PROCEDURES FOR:

- ANALYSIS OF DATA FROM ALL SOURCES
- DEVELOP TECHNOLOGY NEEDS PROPOSALS (TNP)
- SUBMISSION OF TNP TO ARMY MATERIALS & MECHANICS RESEARCH CENTER

CECOM APPLICATIONS GUIDE

- PROVIDE CORROSION PREVENTION AND CONTROL INFORMATION AND GUIDANCE TO DESIGN ENGINEERS, QUALITY CONTROL, INSPECTORS AND PROCUREMENT AND CONTRACTUAL PERSONNEL, WHO ARE INVOLVED IN THE DEVELOPMENT, TESTING AND ACQUISITION OF CECOM ELECTRONICS AND COMMUNICATION EQUIPMENTS.

INCLUDES:

TUTORIAL SECTION
LISTING OF FAILURE TYPES
PREVENTION AND QUALITY CONTROL MEASURES
CONTRACTUAL STANDARD PARAGRAPHS
WARRENTY PARAGRAPHS
DO'S & DON'T'S
REFERENCES

COURSE OUTLINE
CECOM CORROSION PREVENTION & CONTROL (CCPC)
TRAINING PROGRAM

BASIC CORROSION MECHANISMS

RATE FACTORS

SPECIFIC FORMS OF CORROSION IN ELECTRONICS

CORROSION PREVENTION

ENVIRONMENTAL TESTING

CCPC PLAN

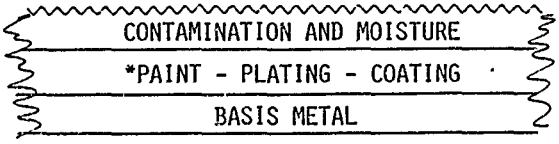
SUMMARY

BASIC CORROSION MECHANISMS

- DIRECT CHEMICAL CORROSION
- GALVANIC CELL CORROSION

DIRECT CHEMICAL CORROSION

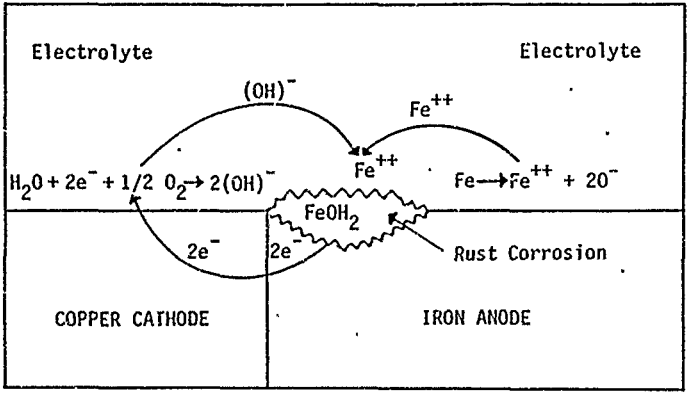
HIGH HUMIDITY



*PAINT, PLATING, COATING ACTS AS PROTECTIVE BARRIER FOR THE BASIS METAL. ANY HOLIDAY OR LACK OF THIS PROTECTIVE LAYER WILL ALLOW THE CONTAMINANT TO ATTACK AND CORRODE THE METAL. THE PROTECTIVE FILM CAN BLISTER, PEEL, LIFT, CRACK, BE ABRADED AND BECOME POROUS AND THUS CAUSE CORROSION OF THE BASIS METAL.

GALVANIC CELL CORROSION

TYPICAL GALVANIC CORROSION CELL



-.20 VOLTS EMF -.70 VOLTS

$FeOH_2$ = YELLOW RUST

ELECTROLYTE = WATER AND CONTAMINANT

GALVANIC CELL CORROSION

GALVANIC CORROSION OCCURS WHEN TWO DISSIMILAR METALS ARE COUPLED TOGETHER IN AN ELECTROLYTE. FOR EXAMPLE, IF A PART MADE OF IRON AND COPPER IS EXPOSED TO A SALT (SODIUM CHLORIDE) SOLUTION, CURRENT WILL FLOW BETWEEN THE IRON (ANODE) AND COPPER (CATHODE) AS SHOWN. THE REACTION PRODUCTS, FERROUS CHLORIDE AT THE ANODE AND SODIUM HYDROXIDE AT THE CATHODE, MEET IN THE MIDDLE TO FORM FERROUS HYDROXIDE WHICH ABSORBS FURTHER OXYGEN AND PRODUCES HYDRATED FERRIC OXIDE OR YELLOW RUST (FROM CORROSION HANDBOOK).

CORROSION RATE FACTORS

- TEMPERATURE
  - TIME
    - MOISTURE
      - CONTAMINANTS
        - POLARITY
          - CORROSION BY-PRODUCTS
            -- EMF
              -- CONTACT AREA

TEMPERATURE

- CORROSION RATES DOUBLE EVERY 18°F INCREASE
- INCREASE IN TEMPERATURE IN AN OPEN CASE DRIES THE INTERIOR AND REDUCES CORROSION RATE
- INCREASE OF TEMPERATURE IN A DAMP BUT CLOSED OR SEALED CASE ACCELERATES CORROSION RATE
- CYCLING TEMPERATURE CAUSES CONDENSATION CORROSION

TIME

CORROSION FAILURES	JUNGLE NUMBER OF JUNGLE FAILURES FOR EACH EXPOSURE, MONTHS			SHORE NUMBER OF SHORE FAILURES FOR EACH EXPOSURE, MONTHS		
FAILURE MECHANISM	7	24	36	7	24	36
END SEAL MIGRATION (ESM)	0	1	1	0	9	9
ELEMENT CORROSION (EC)	0	0	3	1	1	4
ELECTROLYTIC CORROSION (ELC)	0	0	0	0	0	1
SOLDER CORROSION (SC)	0	0	2	0	4	4
SILVER MIGRATION (SM)	0	0	2	0	0	2
CASE CORROSION (CC)	0	1	1	0	1	1

THE ABOVE DATA SHOWS CORROSION FAILURES CAN OCCUR IN THE JUNGLE 24 MONTHS AND AFTER. WHILE AT THE SHORE, CORROSION FAILURES CAN OCCUR 7 MONTHS AND AFTER.

TIME

LEAD WIRE CORROSION FAILURES
AT SHORE SITE

LEAD CORROSION	NUMBER OF FAILURES FOR EACH EXPOSURE, MONTHS 7	24	36
0	19	3	0
X	4	4	1
XX	7	9	8
XXX	3	6	5
----------FAILURE LEVEL----------			
XXXX	0	0	3
XXXX PLUS OPEN CIRCUIT	0	0	1

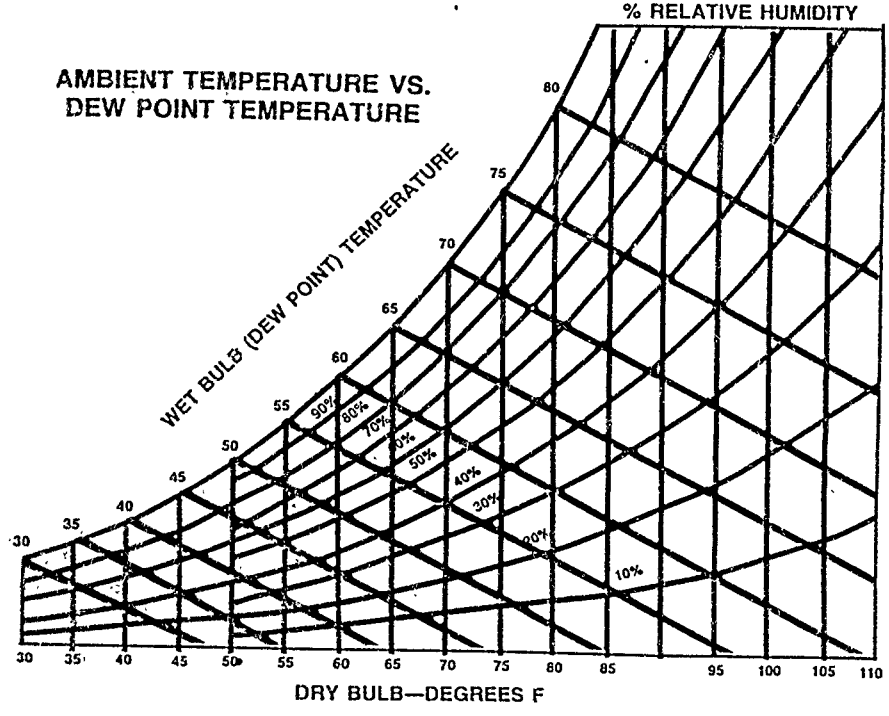
THE ABOVE DATA SHOWS VISIBLE CORROSION OCCURRING ON LEAD WIRES WITHIN 7 MONTHS, BUT OPEN CIRCUIT FAILURES OCCURRING WITHIN 36 MONTHS.

MOISTURE

- MEASURED AS RELATIVE HUMIDITY WHEN PRESENT IN AIR.

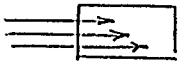
- MOISTURE IS A NECESSARY INGREDIENT IN ELECTROLYTE, NECESSARY FOR CORROSION.

- MOISTURE CAUSES:
  - -- SWELLING OF MATERIALS
  - -- LOSS OF PHYSICAL STRENGTH
  - -- DEGRADES INSULATING MATERIALS
  - -- ELECTRICAL SHORTS
  - -- BINDING OF MOVING PARTS
  - -- OXIDATION
  - -- ACCELERATES CHEMICAL REACTIONS
  - -- CONDENSATION OF MOISTURE DROPLETS ON SURFACES CREATING GALVANIC CORROSION CELL

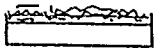

AMBIENT TEMPERATURE VS.
DEW POINT TEMPERATURE
% RELATIVE HUMIDITY
WET BULB (DEW POINT) TEMPERATURE
30
35
40
45
50
55
60
65
70
75
80
90%
80%
70%
60%
50%
40%
30%
20%
10%
30
35
40
45
50
55
60
65
70
75
80
85
95
100
105
110
DRY BULB—DEGREES F

MOISTURE EFFECTS (CONT'D)

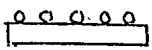
- MOISTURE ABSORPTION - POROSITY



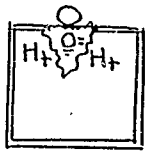
- MOISTURE ADSORPTION - CONTAMINATED SURFACE



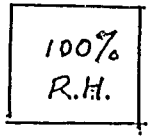
- MOISTURE CONDENSATION - DROPLETS



- CONDENSATION CELLS

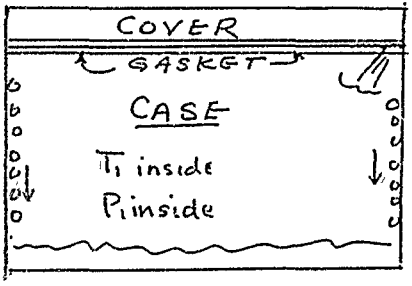


- MOISTURE SATURATION - 100% RH
  A SLIGHT DROP IN TEMPERATURE CAUSES
  FOG, RAIN, CONDENSATION



MOISTURE (CONT'D):

EFFECT OF DEFECTIVE GASKET



T = TEMPERATURE
P = PRESSURE
RH = RELATIVE HUMIDITY

STEPS	EFFECT
1	T_o RISES
2	RH_o RISES
3	P_o RISES
4	P_o INJECTS WET AIR INTO CASE THROUGH PINHOLE
5	RH_i RISES
6	T_o DROPS
7	CASE WALL GETS COLD
8	RH_i CONDENSES DROPLETS ON COLD WALL
9	CONDENSED DROPLETS DRIP DOWN TO BOTTOM
10	RH_i REMAINS AT 100%

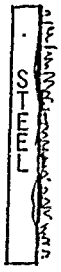
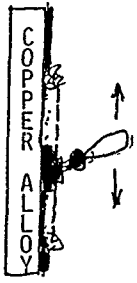
CONTAMINANTS

- PROCESSING VAPOURS
  - PLASTIC OUTGASSING
    - RESIDUAL INGREDIENTS
      - ACIDIC COMPOUNDS
        - HANDLING
          - DUSTS
            - FLORA-FAUNA
              - FUNGUS
                - SALT
                  - PROCESSING RESIDUALS

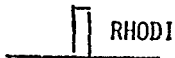
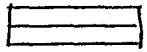
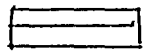
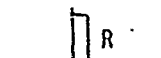
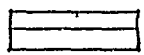
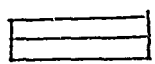
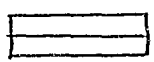
EMF - POLARITY

- EMF POTENTIAL OF EACH METAL TO GO INTO SOLUTION (GALVANIC COUPLES)
- STRAY INTERCIRCUIT EMFs
- EFFECTS OF POOR CONTACTS, GROUNDS
- STRAY EMFs BETWEEN VARIOUS GROUND PLANES
- SPURIOUS SNEAK CIRCUITS

CORROSION BY-PRODUCTS

	 CADMIUM OR ZINC PLATING		
CHEMICAL TREATMENT CREATES ALUMINUM OXIDE: WHICH IS THIN, TOUGH, ADHERENT.	SOFT, FLUFFY, FLAKY WHICH IS EASILY SHAKEN OFF.	HYDROGEN GAS CANNOT ESCAPE. FORMS AN INSULATING LAYER.	MOVEMENT OF CONTACT OR VIBRATION WEARS PLATING, HEATS UP ANY PLASTIC OUTGASSING, POLYMERIZES TO A SOLID.

EMF (CONT'D): EFFECT OF EMF AND CONTACT AREA

EMF & SMALL CONTACT AREA		LARGER CONTACT AREA
 RHODIUM / SILVER	+.05 EMF	
 RHODIUM / NICKEL	0 COMPATIBLE	
 R / Cu	-.20 NOT COMPATIBLE	 COMPATIBLE
 R / Al	-.45 NOT COMPATIBLE*	 NOT COMPATIBLE
 R / Mg	-1.45 NOT COMPATIBLE	 NOT COMPATIBLE

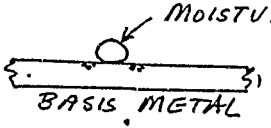
* AS INDICATED IN MIL-F-14072

ELECTRONIC FORMS OF CORROSION

- CORROSION CELL
  - GALVANIC COUPLE
    - PITTING
      - STRESS CORROSION, HYDROGEN EMBRITTLEMENT
        - SILVER MIGRATION
          - INTERGRANULAR CORROSION
            - EXFOLIATION CORROSION
              - PURPLE PLAGUE
                - FILIFORM CORROSION
                  - FRETTING CORROSION
                    - DIRECT CHEMICAL
                      - WHISKER GROWTH

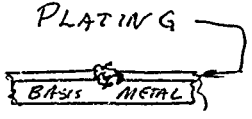
CORROSION CELL

CONDENSATION

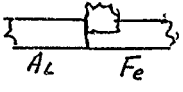


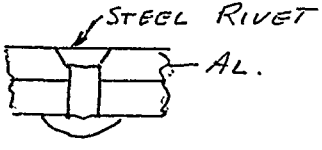
POROUS PLATING

DISCONTINUITY

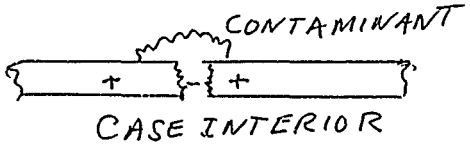


GALVANIC COUPLE





PITTING



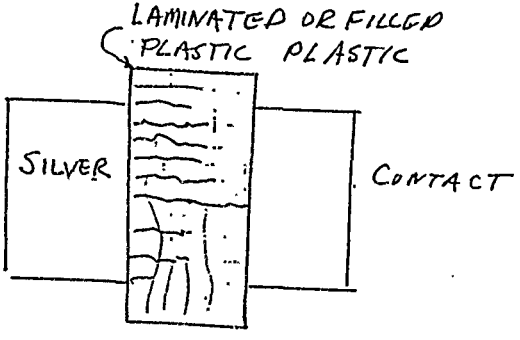
PITTING CAN OCCUR WITH OR WITHOUT A PROTECTIVE BUT POROUS COATING/PLATING. THE BOTTOM OF THE PITS BECOME ANODES IN SMALL CORROSION CELLS WITH SURROUNDING SURFACES ACTING AS CATHODES. IF THE CORROSION PRODUCT IS NOT PROTECTIVE, CORROSION CAN CONTINUE UNTIL A HOLE OCCURS WHICH CAUSES MOIST AIR TO BREATHE INTO THE OTHERWISE SEALED CASE.

STRESS CORROSION CRACKING

(HYDROGEN EMBRITTLEMENT)

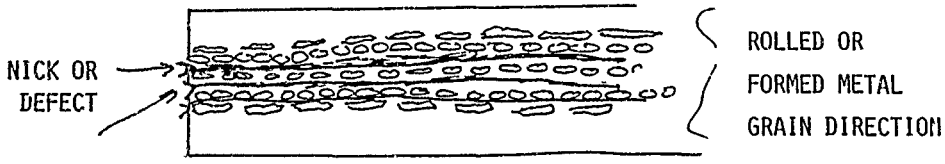
ALLOYS UNDER HIGH TENSILE STRESS ARE SUSCEPTIBLE TO CORROSION STARTING ON THE SURFACE WHICH PROPAGATES THROUGH LATTICE STRUCTURE. STRESS CAN BE RESIDUAL FROM COLD WORKING AND FORMING OR RESULT OF EXTERNAL FORCES; AS IN SPRINGS, ETC. THIS PHENOMENA HAS ALSO BEEN DEFINED AS HYDROGEN EMBRITTLEMENT WHEN HYDROGEN OR HYDROGEN SULFIDE CHEMICALS ARE PRESENT.

SILVER MIGRATION



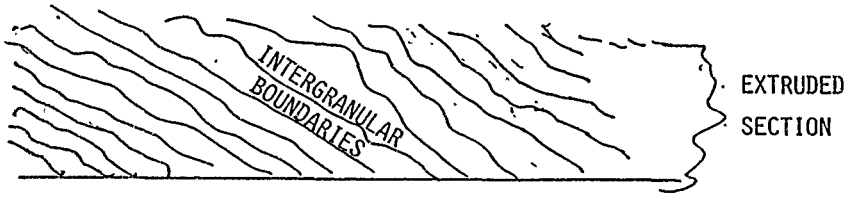
SILVER, USED AS CONTACTS, WITH FILLED PLASTICS AS INSULATORS BETWEEN D.C. POTENTIALS WILL MIGRATE AND FORM SILVER FINGERS, STRANDS WHICH WILL MIGRATE IN THE FILLED PLASTIC INTERSTICES TO THE OPPOSITE CONTACT CAUSING SHORTS.

INTERGRANULAR CORROSION



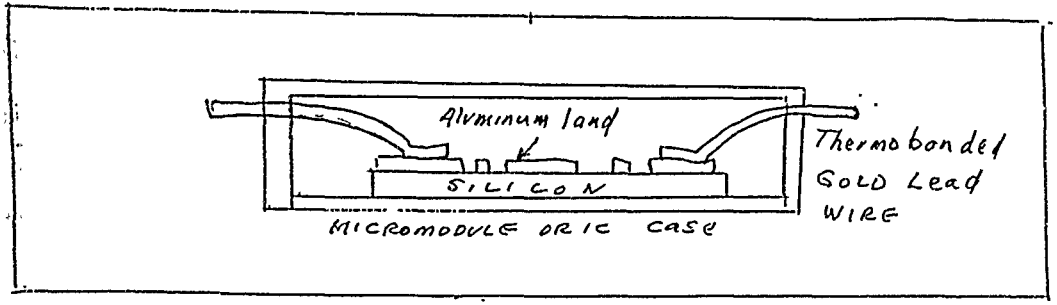
INTERGRANULAR CORROSION IS THE PREFERENTIAL CORROSION AT GRAIN BOUNDARIES OF ALUMINUM-COPPER ALLOYS, STAINLESS STEELS AND HIGH NICKEL ALLOYS. POOR QUENCHING MAY FORM ANODIC (COPPER DEPLETION) ZONES, ALONG WHICH INTERGRANULAR ATTACK WILL OCCUR.

EXFOLIATION CORROSION



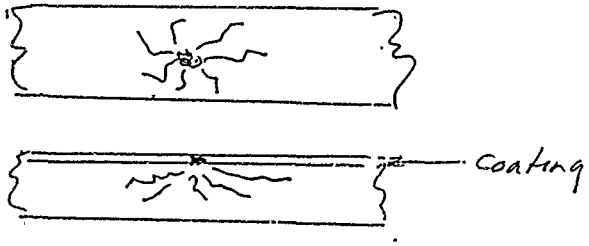
WHEN ELONGATED GRAIN STRUCTURE IS SLIGHTLY PARALLEL TO A SURFACE, THE EXPANSIVE FORCE OF INTERGRANULAR CORROSION PRODUCTS WILL EXPAND AND FORCE GRAIN BOUNDARIES APART AND CREATE A LAMINAR OR LAYER CORROSION KNOWN AS EXFOLIATION CORROSION.

PURPLE PLAGUE



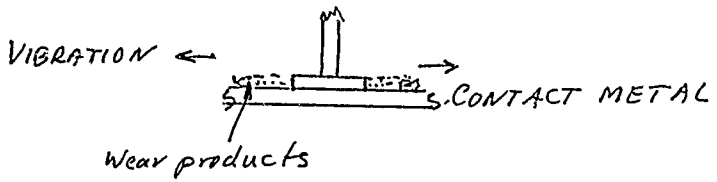
GOLD-ALUMINUM INTERMETALLIC COMPOUND FORMATION - GOLD-ALUMINUM INTERMETALLIC COMPOUND FORMATION (PURPLE PLAGUE) HAS BEEN STUDIED FOR YEARS. THESE COMPOUNDS WILL OCCUR BETWEEN GOLD WIRE BONDED TO ALUMINUM METALLIZATION DEPENDING UPON THE TEMPERATURE-TIME PRODUCT DURING BONDING. CUNNINGHAM AND BROWING DETERMINED THAT INTERMETALLIC COMPOUNDS AS A RESULT OF EACH METAL DIFFUSING INTO EACH OTHER, AND PRODUCED VOIDS WHICH CAUSED EITHER MECHANICAL BOND FAILURES, HIGH RESISTANCE CONTACTS OR OPEN CIRCUITS. THIS TYPE OF FAILURE CAN BE AVOIDED BY CONTROLLING THE BOND CHARACTERISTICS AND THE TEMPERATURE-TIME PRODUCT.

FILIFORM CORROSION



FILIFORM CORROSION IS A SPECIAL FORM OF OXYGEN-CELL CORROSION OCCURRING BENEATH ORGANIC OR METALLIC COATINGS ON STEELS, ZINC, ALUMINUM, OR MAGNESIUM. THE ATTACK RESULTS IN A FINE NETWORK OF RANDOM "THREADS" OF CORROSION PRODUCTS DEVELOPED BENEATH THE COATING MATERIAL WITH SHALLOW GROOVING OF THE METAL SURFACE.

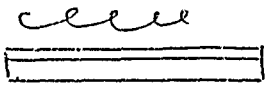
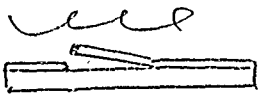
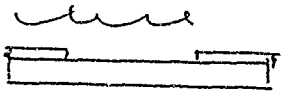
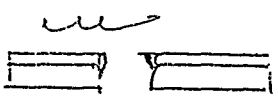
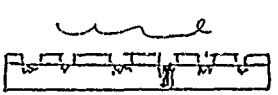
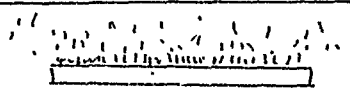
FRETTING CORROSION



FRETTING CORROSION IS DEFINED AS METAL DETERIORATION CAUSED BY REPETITIVE SLIP AT THE INTERFACE BETWEEN TWO SURFACES IN CONTACT. THE INTERFACE MUST BE UNDER LOAD WITH VIBRATORY OR OSCILLATING MOTION IN SMALL AMPLITUDE. RESULTS ARE:

- METAL LOSS IN AREA OF CONTACT
- PRODUCTION OF OXIDE DEBRIS
- GALLING, SIEZING, FATIGUING OR CRACKING OF METAL CONTACT
- LOSS OF DIMENSIONAL TOLERANCES
- LOOSENING OF ATTACHMENTS
- CORROSION OF CONTACT SURFACES

DIRECT CHEMICAL CORROSION

BARE METAL	PROTECTED	POOR PAINT ADHESION
		
PAINT/PLATING HOLIDAY	**PAINT AFTER DRILLING**	**POROUS COATING**
		
BLISTERING	**ABRASION**	**LOOSE, FLUFFY COATING**
		

WHISKER GROWTH

CORROSION PREVENTION

MISSION PROFILE OPERATIONAL MODE

PLATFORM - MANPACK, FIELD PORTABLE, OR SHELTERED

TACTICAL USE - TRANSPORTATION, ENVIRONMENTS

MATERIAL SELECTION

METALS,

FINISHES, COATINGS, PLATINGS, SURFACE TREATMENTS

PLASTICS,

LUBRICANTS, SEALS, GASKETS, HARDWARE

DESIGN FACTORS

CASE DESIGN, SEAL, GALVANIC COUPLE CONTROL

PARTS CONTROL, NON-STANDARD USAGE

LRU, MODULE PROTECTION

CLEANABILITY, DRIABILITY, DECONTAMINATEABILITY

CORROSION PREVENTION

INSPECTION & TEST

- INCOMING INSPECTION, FINISHES, COATINGS, PLATING
- CLEANLINESS TESTS
- PLANT PROCESS CONTROLS
- DT-II, FAT, GROUP C ENVIRONMENTAL TESTS

PROCESS CONTROLS

- METAL FORMING - CLEANING
- FINISHES, COATINGS, PLATINGS
- SOLDERING, JOINING, WELDING
- HANDLING, CLEAN AIR CONTROLS
- PLASTIC TESTING, CURING
- ASSEMBLY CLEANING, CLEANLINESS TESTS
- STORAGE OF IN-PRODUCTION PROCESS SUBASSEMBLIES

CORROSION PREVENTION

PACKAGING, TRANSPORTATION & STORAGE

- SERVICE STORAGE STANDARD
  - PACKAGING
  - TRANSIT CASES
  - DESSICANT, VAPOUR SEAL PACKAGING
  - STORAGE CONDITIONS
  - PERIODIC INSPECTION, TESTING, VISUALS

CORROSION PREVENTION

- MISSION PROFILE - PLATFORM
- MATERIAL SELECTION
- PROCESS CONTROLS
- DESIGN FACTORS
- INSPECTION & TEST
- PACKAGING, TRANSPORTATION & STORAGE, SSS
- FIELD MAINTENANCE
- OVERHAUL
- FIELD USAGE

ENVIRONMENTAL TESTING

MIL-STD-810

- RAIN, METHOD 506.2
- HUMIDITY, METHOD 507.2, PROCEDURE III
- FUNGUS, METHOD 508.3
- SALT FOG, METHOD 509.2
- LEAKAGE, IMMERSION, METHOD 512.2
- FAILURE ANALYSIS
- PASS/FAILURE CRITERIA
- FIELD CORRELATION, BATHTUB CURVE

ENVIRONMENTAL TESTING (CONT'D)

MIL-STD-810-TEST	PASS/FAILURE CRITERIA (P/FC)
o METHOD 506.2 RAIN FOR NON-SHELTERED ITEMS ONLY	ENTRAPPED EXCESS MOISTURE SHALL BE CAUSE FOR FAILURE
o METHOD 507.2-3 HUMIDITY PROCEDURE III AGGRAVATED 10 CYCLES	PROCEDURE III AGGRAVATED, 10 CYCLES SEALED EQUIPMENTS:
- EXPOSE GASKET SEALED EQUIPMENT OPEN	CHECK FOR CORROSION WITH A 5 POWER AMPLIFICATION. ANY EVIDENCE OF CORROSION SHALL BE CAUSE FOR FAILURE. ALSO, CHECK ALL MOVING PARTS, SWITCHES, CONTROLS, ETC.
- OPEN NON-SEALED	CHECK FOR MOISTURE ACCUMULATIONS AND CORROSION. ANY EVIDENCE OF CORROSION AND/OR LIFTING, PEELING, BLISTERING OF PAINTS, COATINGS OR PLATINGS SHALL BE CAUSE FOR FAILURE.

ENVIRONMENTAL TESTING (CONT'D)

MIL-STD-810-TEST	PASS/FAILURE CRITERIA (P/FC)
o METHOD 508.3 FUNGUS OPEN ALL GASKET SEALED ASSEMBLIES. CONDUCT FOR 28-DAY PERIOD OF EXPOSURE.	INSPECT FOR CORROSION WITH A 5 POWER LOUPE. CHECK ALL MOVING ITEMS FOR BINDING AND ANY LIFTING, PEELING, BLISTERING OF PAINTS, COATINGS OR PLATINGS SHALL BE CAUSE FOR FAILURE.
o METHOD 509.2 SALT FOG BEFORE WASHING OR CLEANING THE EQUIPMENT, CONDUCT INSPECTION.	(SAME AS ABOVE)
o METHOD 512.2 LEAKAGE IMMERSION	BEFORE IMMERSION, WEIGH CLOSED CASE AFTER DRYING. AFTER IMMERSION, DRY CLOSED CASE FOR 2 HOURS AT ROOM TEMPERATURE AND REWEIGH CLOSED CASE. OPEN CASE AND LOOK FOR TRAPPED WATER IN CASE OR CONDENSATION. ANY GAIN IN WEIGHT SHOULD BE CAUSE FOR FAILURE.

FAILURE ANALYSIS

VISUAL - EYEBALL
5 POWER LOUPE
MICROSCOPIC

OBSERVATIONS - FORM OF CORROSION
LOCATION
CORROSION BY-PRODUCT - COLOR, TEXTURE, LOCATION
AREA/VOLUME COVERED, SHAPE
METALLIC COUPLES INVOLVED
BASIS METAL
PROTECTIVE FINISH
FINISH ADHESION
CONTAMINANT

FAILURE IMPACT - OPEN CIRCUIT, SHORT CIRCUIT, LOSS OF SEAL

CIRCUIT LOCATION - PWA, POWER SUPPLY, RT CASE GASKET, CONNECTOR, PART

PASS/FAIL CRITERIA

TYPE	EFFECT
LOCAL OR EXTENSIVE AREAS	COSMETIC OR FUNCTIONAL
FUNCTIONAL LOCATION	
CRITICALITY OF ELECTRONIC FUNCTION I.E., PWA, CONNECTOR PINS	FUNCTIONAL FAILURE
CRITICALITY OF MECHANIC FUNCTION	MECHANICAL FAILURE
LOOSE CORROSION PRODUCT	FUNCTIONAL FAILURE
GALVANIC CORROSION	MECHANICAL OR FUNCTIONAL

CURRENTLY, THERE IS NO ESTABLISHED PASS/FAIL CRITERIA APPLICABLE TO CECOM ELECTRONICS. THIS IS A TNP. THE ABOVE LISTED FACTORS OF A CORROSION INCIDENCE SHOULD BE CAREFULLY EVALUATED FOR EACH INDIVIDUAL INSTANCE OF CORROSION. EACH INITIATION OF A CORROSION INCIDENCE WILL CONTINUE TO DEVELOP UNTIL FAILURE OCCURS OR A COSMETIC DEGRADATION OCCURS. IN EACH CASE, THAT PART OR LRU SHOULD BE FAILED AND REPLACED. IF A SUMMARY DECISION CANNOT BE REACHED, THEN THE PART OR LRU SHOULD BE SAMPLED AND TESTED PER THE SALT FOG TEST TO FURTHER DETERMINE POTENTIAL FOR FAILURE.

FIELD MAINTENANCE (OPERATOR)

CLEANING

DRYING

TRANSIT CASE USAGE

MAINTENANCE MANUAL DESCRIPTION OF ABOVE

FIELD USAGE (OPERATOR)

OPERATING, NON-OPERATING EFFECTS

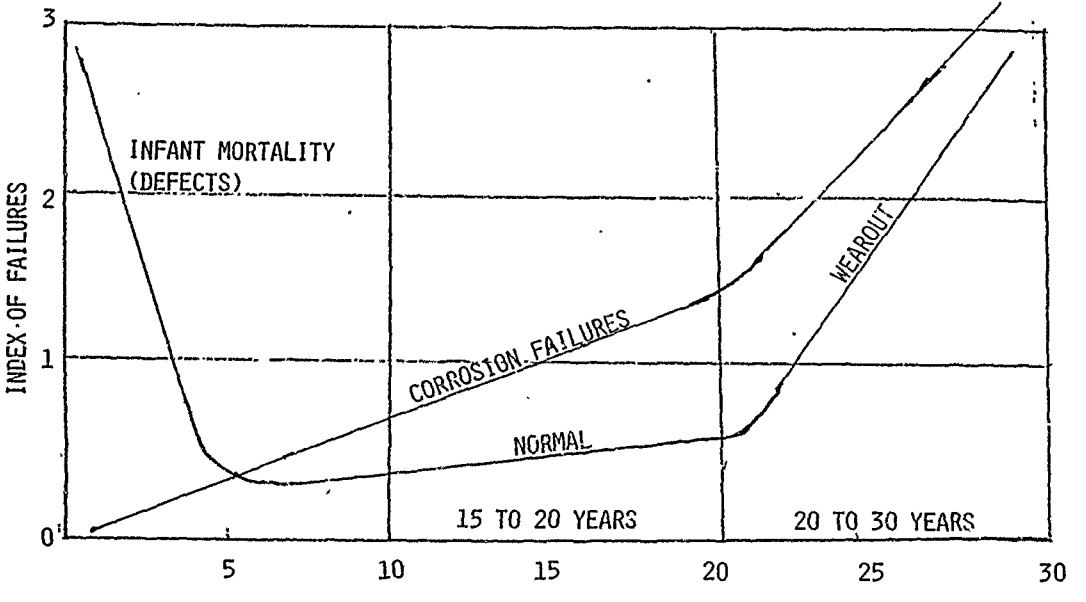
TRANSIT CASES

RIVER FORDING

CLEANING, DRYING

ENVIRONMENTAL TESTING

BATHTUB CURVE



INFANT MORTALITY INCLUDES DESIGN AND WORKMANSHIP DEFECTS WHICH CAN LEAD TO CORROSION.

CORROSION PREVENTION & CONTROL PLAN (CPCP)

CONTRACTUAL SOWs FOR EACH ACQUISITION & FIELDING PHASE

CONCEPT EXPLORATION

ROC, MISSION PROFILE, OPERATIONAL MODE

PLATFORM CATEGORY, FIELD ENVIRONMENT PROFILE

DEMONSTRATION & VALIDATION

DRAFT CPC PLAN (OUTLINE)

TEMP = ENVIRONMENTAL TESTS, RELIABILITY CRITICAL ITEMS

FIELDING

MONITOR WARRANTY PLAN

PARTICIPATE IN FIELDED SURVEYS

MONITOR SSS PROGRAM

CPCP: CONCEPT EXPLORATION (CE)

VARIOUS CONCEPTS AND APPROACHES ARE EXPLORED.

CE: REQUIRED OPERATIONAL CAPABILITY (ROC)

- DESCRIBES: MISSION PROFILE (MP)
  OPERATIONAL MODE (OM)
  BEST OPERATIONAL CAPABILITY (BOC)

- DEVELOP: PLATFORM CAPABILITY
  I.E. MANPACK?
  FIELD PORTABLE?
  VEHICULAR?

  FIELD ENVIRONMENT PROFILE
  I.E. TROPICAL?
  MARINE?
  ARCTIC?

  FIELD SERVICE LIFE
  I.E. 10 YEARS?
  20 YEARS?

CPCP: DEMONSTRATION & VALIDATION (D&V)

D&V: CANDIDATE DESIGNS ARE STUDIED
TRADE-OFF DESIGNS, DESIGN PLANS ESTABLISHED
TEMP OUTLINE DEVELOPED

PARTICIPATE: DESIGN DECISIONS
SYSTEM PACKAGING
PROTECTIVE MEASURES?
CASE DESIGNS?
CRITICAL CIRCUITS PROTECTED?

TEMP: CORRECT ENVIRONMENTAL TESTS?
FAILURE ANALYSIS?
CORROSION PASS/FAIL CRITERIA?

CPCP: DEMONSTRATION & VALIDATION (D&V) (CONT'D)

DRAFT CPCP

COMPARE TO CECOM SUPPLEMENT OF DARCOM-R-702-24

CHECK MANAGEMENT

PROTECTION PLANNED

MAINTENANCE PLANNED

CLEANABILITY, DECONTAMINATEABILITY REQUIREMENTS

PARTS, MATERIALS, PROCESS CONTROLS, MIL-P-11268, MIL-F-14076, MIL-STD-454

WARRANTY PLANS

CPCP FULL SCALE DEVELOPMENT (FSD)

IN FSD, FULL SCALE ENGINEERING MODELS ARE TESTED FOR OPERATION, COMPLIANCE WITH SPECIFICATIONS AND RESISTANCE TO DETERIORATION IN THE FIELD.

FSD MODEL DESIGN

REVIEW FOR CORROSION RESISTANCE DESIGN

- MATERIALS?
- PROTECTIVE COATINGS, PLATINGS, FINISHES?
- PROTECTED RELIABILITY CRITICAL LRUs?
- CLEAN, CLEANLINESS, CLEANABILITY?
- DECONTAMINATEABILITY?

REVIEW DT/OT-II ENVIRONMENTAL TEST RESULTS

- ANY VISIBLE CORROSION?
- MALFUNCTION MOVING PARTS?
- FAILURE ANALYSIS CONDUCTED?
- TNPs?
- CORRECTIVE MEASURES?

UPDATED CPCP?

CPCP PRODUCTION

PREPRODUCTION AND/OR FIRST ARTICLE TESTS (FAT) ARE CONDUCTED ON PRODUCTION QUALITY MODELS. ALSO, GROUP C PERIODIC SAMPLING TESTS ARE CONDUCTED.

MONITOR CPC PLAN:

- QUALITY CONTROL OF MATERIALS, PARTS, LRUs
  - FINISHES, COATINGS, PLATINGS?
- REVIEW RESULTS OF FAT AND GROUP C TESTS
  - ANY CORROSION FAILURES?
  - FAILURE ANALYSIS?
  - CORRECTIVE ACTION?
- REVEIW ECPs
  - EFFECT ON CORROSION RESISTANCE?

CPCP PRODUCTION (CONT'D)

REVIEW SSS

- PACKAGING TYPE, QUALITY?
- RH INDICATOR?
- PERIODIC TESTING?
- STORAGE CONDITIONS?

FINAL WARRANTY CONDITIONS

- SERVE ON CORROSION REVIEW GROUP
- FAILURE ANALYSIS?
- CORRECTIVE ACTION? TNP?

FIELD MANUALS

- ADEQUATE?
- CONTAIN CLEANING & DRYING INSTRUCTIONS?
- PREVENTIVE MANUALS CONTAIN CORROSION PREVENTION RULES?

CPCP: FIELDING

FOR A SPECIFIED NUMBER OF YEARS, THE WARRANTY PLAN WILL BE IN EFFECT, HOWEVER, AFTER THAT, ORGANIC MAINTENANCE WILL CONTINUE. IT HAS BEEN TRADITIONALLY DIFFICULT TO ACQUIRE FIELD CORROSION FAILURE DATA. DEPOTS PERFORM OVERHAUL AND REPAIR, AND ALSO CONTROL STORAGE.

MONITOR WARRANTY PLAN

- SERVE ON WARRANTY CONTROL BOARD
- IDENTIFY CORROSION FAILURES
- PROCESS TNPs
- COLLECT CORROSION FAILURE DATA

PARTICIPATE IN FIELDED SURVEYS

- COLLECT CORROSION FAILURE DATA
- PROCESS TNPs
- UPGRADE MAINTENANCE MANUALS

MONITOR SSS

- CHECK STORAGE
  - ADEQUACY OF PACKAGING
  - TNPs

SUMMARY

- THE MISSION PROFILE, MODE OF OPERATION, LIFE CYCLE ENVIRONMENTAL PROFILE AND PLANNED PLATFORM USE SHALL BE USED TO DEVELOP DEGREE OF CORROSION PREVENTION AND CONTROL REQUIRED.

- CORROSION PREVENTION AND CONTROL IS ACHIEVABLE BY REQUIRING AND ENFORCING CURRENTLY AVAILABLE CECOM SPECIFICATIONS AND STANDARDS; WHICH, BECAUSE OF RAPIDLY CHANGING TECHNOLOGIES, NEED TO BE CONTINUALLY UPGRADED.

- A CPC PLAN SHOULD BE GENERATED IN THE ADVANCED DEVELOPMENT ACQUISITION PHASE AND UPDATED IN EVERY ONGOING PHASE.

- ALL DESIGN DECISIONS AND MATERIALS SELECTION, INCLUDING ECPs, SHOULD BE REVIEWED FOR IMPACT ON CORROSION RESISTANCE.

- SSSs SHOULD INCLUDE REQUIREMENTS FOR PROTECTIVE STORAGE AND PERIODIC INSPECTIONS FOR CORROSION AND VISUAL RH INDICATORS.

SUMMARY (CONT'D)

- MAINTENANCE MANUALS SHOULD DESCRIBE CLEANING PROCESSES, NON-CORROSIVE CLEANING FLUIDS AND SUITABLE DRYING PROCEDURES.
- ANY SIGN OF CORROSION, AFTER TEST OR IN THE FIELD SHOULD REQUIRE CORRECTION, SINCE CORROSION ONCE STARTED IS PROGRESSIVE AND DOES NOT REVERSE.
- ALL ELECTRONIC OR MECHANICAL FAILURES SHOULD BE SUBJECT TO FAILURE ANALYSIS TO DETERMINE IF ROOT CAUSE OF FAILURE IS CORROSION.
- WARRANTIES SHOULD SPECIFICALLY INSURE AGAINST CORROSION FAILURES.
- ENVIRONMENTAL TESTS, WITH PROPER SEVERITY, WILL DISCLOSE CORROSIVE POTENTIALS. (FR)